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09/901,087	07/10/2001	Yoshiyuki Kuramoto	684.3216	7072

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EXAMINER
ARTMAN, THOMAS R

ART UNIT	PAPER NUMBER
2882	

DATE MAILED: 07/18/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/901,087	Applicant(s) KURAMOTO, YOSHIYUKI
	Examiner Thomas R Artman	Art Unit 2882

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *31 March 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *26 and 27* is/are allowed.

6)☒ Claim(s) *1-25 and 28* is/are rejected.

7)☒ Claim(s) *1-5,9-18,22-25 and 28* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *31 March 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Objections

Claims 1, 13, 14, 25 and 28 are objected to for have improper functional limitations. The functionality of the interferometer and computing unit as claimed in the above apparatus claims is not significant without being cast in appropriate "means plus function" language. As written, the limitations are not tied to the specific physical structure of an interferometer or the presence of a computing unit.

Regarding claims 2-5, 9-12, 15-18 and 22-24, these apparatus claims are dependent, directly or indirectly, upon the above independent claims, and are therefore objected to. Furthermore, the further limitations of the functionality of the calculation unit disclosed in these claims do not remedy the objectionable language in the independent claims.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-5, 9-18, 22-25 and 28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki (US 5,898,501).

Regarding claims 1, 13, 14, 25 and 28, Suzuki discloses an interferometer (Fig.1) than measures transmission wavefronts of a test lens/objective (item 6) at a plurality of measurement points (see, by way of example, col.2, lines 22-35, and col.3, lines 4-52), including:

1) an interferometer (Fig.1) that is arranged to measure transmission wavefronts separately or sequentially in relation to at least one of a plurality of measurement points defined along a plane perpendicular to the optical axis of the imaging optical system under test where the imaging side and object side imaging locations of the plurality of measurement points are measured (stages 3 and 5 are movable in the X, Y and Z directions, see above citations, as well as col.5, lines 10-17), and

2) a computing unit (item 7) that is in communication with the interferometer and is operable to calculate at least one wavefront aberration, imaging state, distortion and curvature of field on the basis of information regarding the transmission wavefronts and the position coordinates of the object side and imaging side imaging points.

Suzuki does not disclose the additional computing function of taking one of the measurement points as a standard (reference) point and using the standard point values to correct

data collected from the other measurement points. However, one skilled in the art would contend that a computing unit can be made operable to perform any sort of calculation as desired. Suzuki's calculation unit is no exception.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the computing unit operable to use one of the measurement points as a reference in order to correct calculated values, since it would only require a software modification to the existing structure.

With respect to claims 2 and 15, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make a computing unit operable to repeat the measurements. This is a simple, common procedure that is expected throughout research and industry. Proving reproducibility in data sets is paramount for increasing the confidence in the accuracy and precision in the measured data.

With regards to claims 4 and 16, it would have been obvious to one of ordinary skill in the art at the time the invention was made to pick a standard, or reference, point on the optical axis of the test object. Lens systems under test are typically circular, and the optical axis, being in the center of the cross-section, provides a natural origin for a polar coordinate system. Such systems have circular symmetry that one skilled in the art would automatically use for plotting data from an object with a circular cross section.

In regards to claims 5 and 17, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the standard, or reference, point as the relative position for the coordinate system. A standard point is useless and indistinguishable from all other points unless it is being used as a reference by which all other points are compared.

With respect to claims 9-10 and 22-23, Suzuki's interferometer measures multiple points by moving the X, Y, Z stages at the object side and imaging side of the test lens and uses position sensing interferometers for monitoring the positions of the stages (col.3, lines 4-17).

With regards to claims 11 and 24, Suzuki's interferometer is arranged such that the chief ray falling upon an imaging point is registered with a chief ray of the optical axis of the optical system under test.

In regards to claim 12, Suzuki's measurements including distortion and curvature of field, as mentioned previously.

With respect to claim 18, it would have been obvious to one of ordinary skill in the art at the time the invention was made to make a computing unit operable to calculate corrected values by subtracting the amount of change from the measured values. When providing any kind of correction, particularly with calibration data or background subtraction routines on various types of spectrometers, for example, the correction is almost universally achieved by subtracting the change, drift, etc., from the measured values. Further, such calculations are always with respect

to time. For example, the known methods of calibration are performed by taking calibration data before the measurements, and backgrounds are usually run before measurements are taken, in the example of spectrometric analyses.

Claims 3, 6-8 and 19-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki and in view of LaFleur (US 5,815,268).

With respect to claim 3, Suzuki does not disclose the ability to measure two points simultaneously. LaFleur teaches such a structure that allows at least a pair of points to be measured simultaneously. Not only is this a time saving feature, but also it allows rejection of noise caused by external or internal events, such as vibrations, when comparing the data without the need for extra structure or computations.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to measure at least two points simultaneously such that common mode rejection of noise can be made and the process time or testing the object can be greatly reduced.

Regarding claims 6, 8, 19 and 21, Suzuki does not disclose more than one optical system to measure the same number of measurement points.

LaFleur discloses a wavefront measuring optical interferometer (Fig.1) that measures a plurality of measurement points with an optical system corresponding to each measurement point (each pinhole in item 12 and each reflector portion of item 18). It allows significantly faster testing times, which has great economic advantages (col.1, lines 14-21).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide an optical system for each measurement point as taught by LaFleur such that the entire test object can be measured at one time. Such an arrangement has a huge economic advantage of taking far less time during the inspection process.

With respect to claims 7 and 20, Suzuki teaches the advantages and well-known use of movable stages for taking multiple measurements (col.3, lines 4-17).

Allowable Subject Matter

Claims 26 and 27 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

The prior art made of record teaches the general structure and practice of using a Fizeau interferometer for performing wavefront aberration, image distortion, distortion and curvature of field measurements at various points lying in a plane perpendicular to the optical axis of an image projection system under test. In particular, Suzuki teaches such an interferometer that uses it's computing unit in a method of calculating simulated wavefronts and determining the required correction profile for the test lens/objective based upon the measured wavefronts (see col.2, lines 22-35, and col.3, lines 4-52).

However, none of the references, alone or combined, disclose or reasonably teach the additional combination of method steps of measuring an imaging optical system by:

1) calculating a transmission wavefront as measured by the interferometer and a wavefront aberration, imaging state, distortion, or curvature of field using the measured wavefront data taken at several objective side and imaging side imaging points as measurement points, and

2) correcting a measured value related to a wavefront aberration, an imaging state, distortion, or curvature of field of the imaging optical system by using one of the measurement points as a standard, or reference, point.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Bray (US 5,838,442) discloses a wavefront measurement device that has a reference point, but it is the position of the detected image that is used to align beam steering optics rather than correct any waveform aberration data. Ukaji (US 2001/0001577) discloses the common practice of using interferometric stage position sensors. Stenton (US 6,480,284) teaches the practice of using calibration data collected before measurements are taken in order to correct the acquired imaging data. Kawasaki (US 6,473,186) teaches the use of using a standard point among a set of reference points for repositioning portions of an interferometer for measuring multiple points sequentially: the data is not used in any corrections as outlined in part (2).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thomas R Artman whose telephone number is (703) 305-0203. The examiner can normally be reached on 8am - 5:30pm Monday - Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Robert Kim can be reached on (703) 305-3492. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-1782.

Thomas R. Artman
Patent Examiner
June 3, 2003

DAVID V. BRUCE
PRIMARY EXAMINER